Book of Abstracts

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„Wood modification research & applications“

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Salzburg University of Applied Sciences
Forest Products Technology & Timber Constructions

in collaboration with
the Society of Wood Science and Technology &
the European Conference on Wood Modification

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Understanding wood modification through an integrated scientific and environmental impact approach (ModWoodLife)

Wood modification research & applications

Third COST Action FP1407 International Conference

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Prediction of mass loss dynamics during wood thermal modification under industrial conditions

Bo-Jhih Lin[1], Edgar Silveira[1], Baptiste Colin[1], Anélie Pétrissans[1], Wei-Hsin Chen[2], Patrick Rousset[3], Mathieu Pétrissans[1]

[1] Laboratoire d'Etudes et de Recherches sur le Matériau Bois, EA4370, Université de Lorraine USC INRA, IUT Epinal - Hubert Curien, Epinal Cedex 88010, France

e-mails: bo-jhih.lin@univ-lorraine.fr; edgar.silveira@univ-lorraine.fr; baptiste.colin@univ-lorraine.fr; anelie.petrissans@univ-lorraine.fr; mathieu.petrissans@univ-lorraine.fr

[2] Department of Aeronautics and Astronautics, National Cheng Kung University, Tainan 701, Taiwan; chenwh@mail.ncku.edu.tw

[3] French Agriculture Research Centre for International Development (CIRAD), Montpellier 34398, France; patrick.rousset@cirad.fr

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Thermal modification is an efficient way to improve some wood properties, like equilibrium moisture content (EMC), dimensional stability and durability (Esteves and Pereira 2009), to produce a wood modified material. According to the literature (Candelier et al. 2016), it has been observed that the thermal degradation of wood has a high dependence on the initial wood characteristics (wood specie, density) and process parameters, such as drying stage, heating medium, and treatment intensity (heating rate, temperature and duration). The objective of this study is to predict the treatment duration in order to reach a particular level of wood modification under industrial conditions. For that, the mass loss dynamics during the treatment are recorded and modelled. The flow chart of research methodology is shown in Fig. 1.

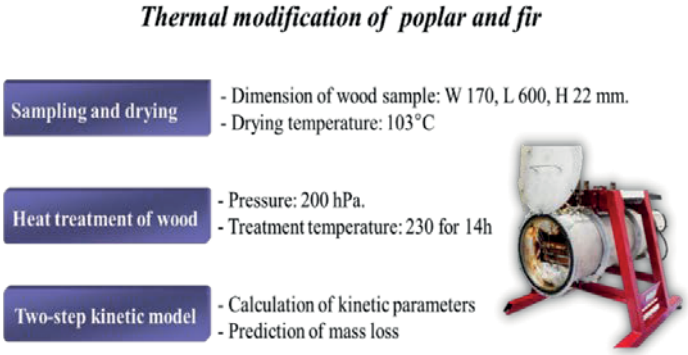

Figure 1: The flow chart of thermal modification of poplar and fir

The obtained results are encouraging for a future development of a numerical tool able to conduct performing the heat treatment of wood in industry. The experiments were carried out on wood boards (30 x 22 x 2.5 cm^3) in a pilot scale system, under conditions close to the industrial ones (heat transfer by conduction with 0.2°C min^{-1} heating rate under vacuum). Two different wood species, a hardwood: the poplar (*Populus nigra*) and a softwood: the fir (*Picea abies*), were used. The heat treatment was conducted at 230 °C for 14 hours under low air pressure (200 hPa) with less than 5% oxygen content. 14 hours duration is examined to obtain kinetic profiles required for the modelling, while usual treatment duration in the industry is close to 1 to 5 hours. Results of the present work are shown in Fig. 2. They indicate that the mass loss of poplar (14.21 wt%) is higher than fir (10.45 wt%). The difference of thermal sensitivity between poplar and fir is due to the hemicelluloses composition of hardwood and softwood (Chaouch et al. 2010). Moreover, if the target of the wood modification is to reach 10 wt% of mass loss, the duration for the poplar is closed to 750 min and 1200 min for the fir. This first observation allowed selecting the hardwood specie in priority to limit the heating energy consumption and carbon footprint, as well as optimize the economical balance.

A two-step kinetic model (Di Blasi and Lanzetta 1997) is adopted to predict the mass loss dynamics of poplar and fir. The kinetic parameters are calculated from experimental data by curve-fitting. A good agreement between modelled and experimental data is achieved for both two species. This model can be integrated in the development of a numerical tool able to give recommendations to the industry by the prediction of the treatment time to modify wood specie for reach required properties.

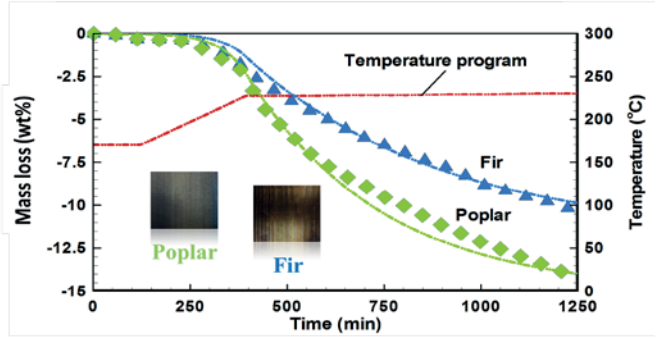

Figure 2: Modelled (lines) curves for poplar (green) and fir (blue) during heat treatment.

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